## Space Weather Technical Forecast

Issued on Tuesday 5 November 2024 at 00:33 Local

**This technical forecast provides a four-day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales**

---

**Space Weather Forecast Headline: Moderate to High solar activity with M-flares expected, and a slight chance of X-class flares.**

**Analysis of Space Weather Activity over past 24 hours**

**Solar Activity:** Solar activity was moderate with several M-flares over the past 24hrs, the largest of which was an M5.5 at 04/1538 UTC from AR3883 in the southeast disc. There are twelve active sunspot regions visible on the solar disc, including two unnumbered regions. In the southeast, AR3883 has generated multiple M-class solar flares and features three delta spots. The large forward delta spot in this region has now divided into two smaller delta areas, with an additional delta region in its trailing spot. Although the region's magnetic complexity has decreased somewhat in recent hours, its penumbral area has slightly expanded. AR3878 contains a small, weak delta spot in its trailing region, although it continues to decline. AR3881, to the west of centre disc, has lost its small delta spot, with most of its intermediate spots now faded. Spots AR3869-AR3873 continue to approach or rotate around the western limb and as such are difficult to analyse. AR3886 on the eastern limb is gradually coming more into view; it appears to be a sizable region with multiple spots, though it may be split into smaller regions upon further analysis as it rotates further away from the limb. The remaining spots on the disc are comparatively smaller or less magnetically complex.

A CME was observed off the E limb in association with the M3.8 flare from AR3883, with initial assessment suggesting the CME will miss behind Earths orbit. Gaps in available imagery however mean this is currently lower confidence.

**Solar Wind / Geomagnetic Activity:** Solar winds as measured at L1 by ACE/DSCOVR were at slightly elevated levels throughout, generally between 420-470km/s. Density was initially above average, but fell to below average from around 04/0500UTC. The Interplanetary Magnetic Field (IMF), Bt, was predominantly weak, around 5-8nT. The north-south component, Bz, was initially weakly negative (southward directed), but then oscillated between positive and negative from around 04/1200UTC, ranging through between +7nT and -6nT. Phi angle was persistently positive (away from the Sun). Geomagnetic activity was active (Kp4) between 04/0000-04/0300UTC and saw a G1/Minor Geomagnetic Storm (Kp5) interval between 04/0300-0600UTC, before becoming Quiet to unsettled (Kp0-3) for the rest of the period.

**Energetic Particles / Solar Radiation:** High energy proton flux observed by GOES18 fell to background levels through the period. High energy electron flux (greater than 2MeV) observed by

---

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

GOES16 was at Background. The associated 24-hour fluence was well below the Active threshold, with 1.56e6 integrated flux observed at 05/0001UTC.

**Four-Day Space Weather Forecast Summary**

**Solar Activity:** Moderate to High activity is expected to continue, with occasional M-class flares expected and a slight chance of isolated X-class flares.

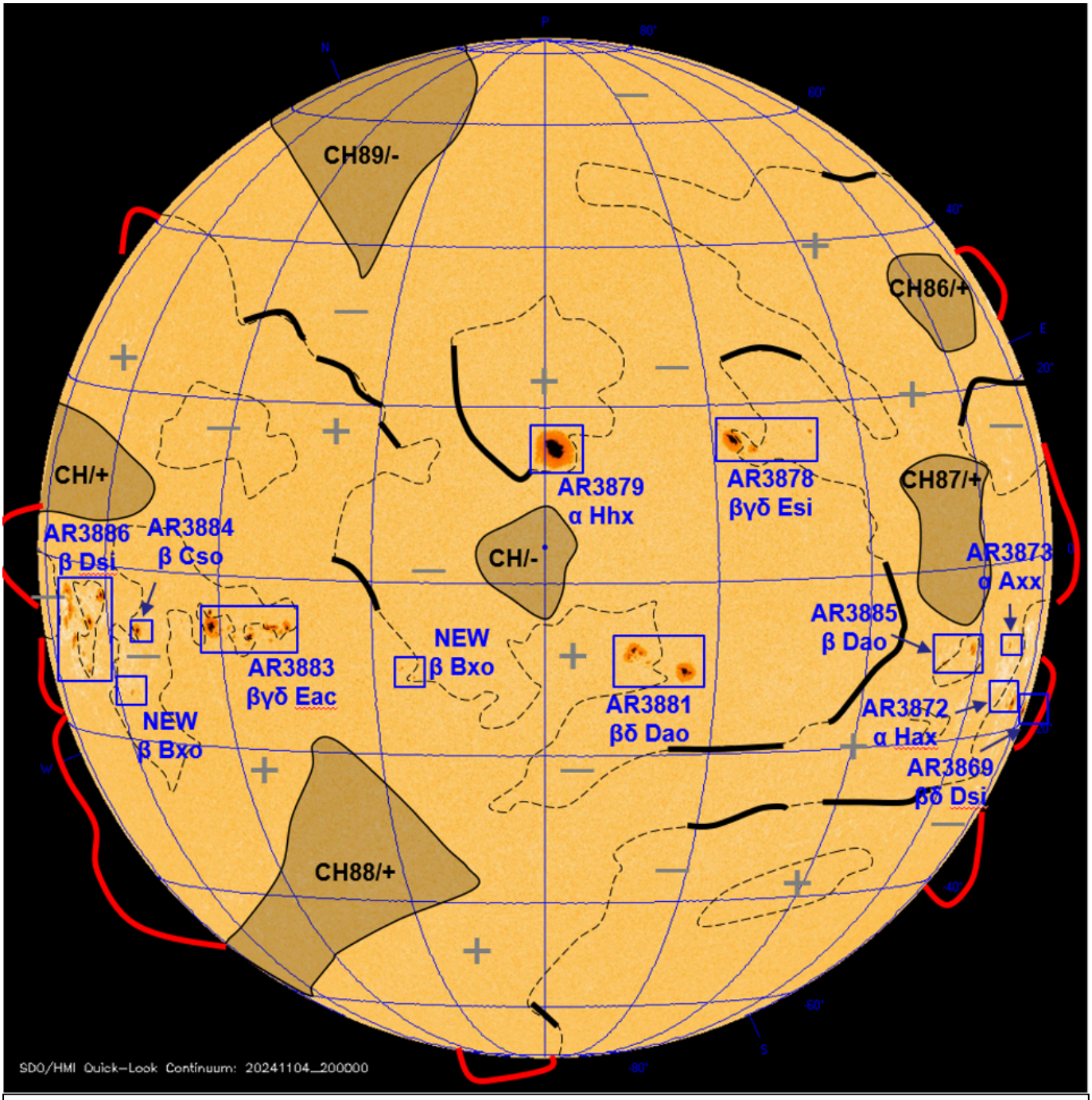
**Solar Wind / Geomagnetic Activity:** Connection to coronal hole fast winds is ongoing, albeit weakly, with enhancement expected to continue through Day 1 (05 Nov). Further HSS enhancement is possible later Day 3 (07 Nov) or early Day 4 (08 Nov), although this is low confidence. Generally Quiet to Unsettled geomagnetic activity is expected through Day 1 (05 Nov), with a chance of Active and a slight chance of G1/Minor Geomagnetic Storm intervals given the ongoing weak HSS influence. Activity then expected to decline to mainly quiet levels through Day 2 (06 Nov), before perhaps becoming unsettled to active later Day 3 or early Day 4 (07-08 Nov), with a chance of G1/Minor geomagnetic Storm intervals due to further HSS influence.

**Energetic Particles / Solar Radiation:** The high energy proton flux at GOES-18 has now declined to background levels, with only a slight chance of any further enhancement. The high energy electron flux is expected to be Background to Moderate, with the associated fluence forecast to persist below Active levels.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

**Figure 1: Solar Synoptic Map valid 04/2000UTC.**




**Key:** Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

## Geomagnetic Storms

A CME was observed off the E limb in association with the M3.8 flare from AR3883 at 04/0141UTC, with an associated Type II radio emission of 307km/s. Analysis remains difficult due to coronagraph imagery gaps, but an initial assessment has the bulk of the CME passing behind Earths orbit.

The near Earth environment continues to be weakly enhanced with winds currently at slightly elevated levels, likely as a result of a weak connection to coronal hole CH87/+, or perhaps CH86/+. A stronger connection cannot be ruled out, perhaps raising solar winds to elevated levels Day 1 (05 Nov). An unnumbered coronal hole near centre disc may also give an enhancement in solar winds later on day 3 (07 Nov) but as this feature is non-recurrent confidence is low. MOSWOC's ENLIL model shows speed increases from HSS influence but recent discrepancies with observed solar wind speeds have reduced forecast confidence.

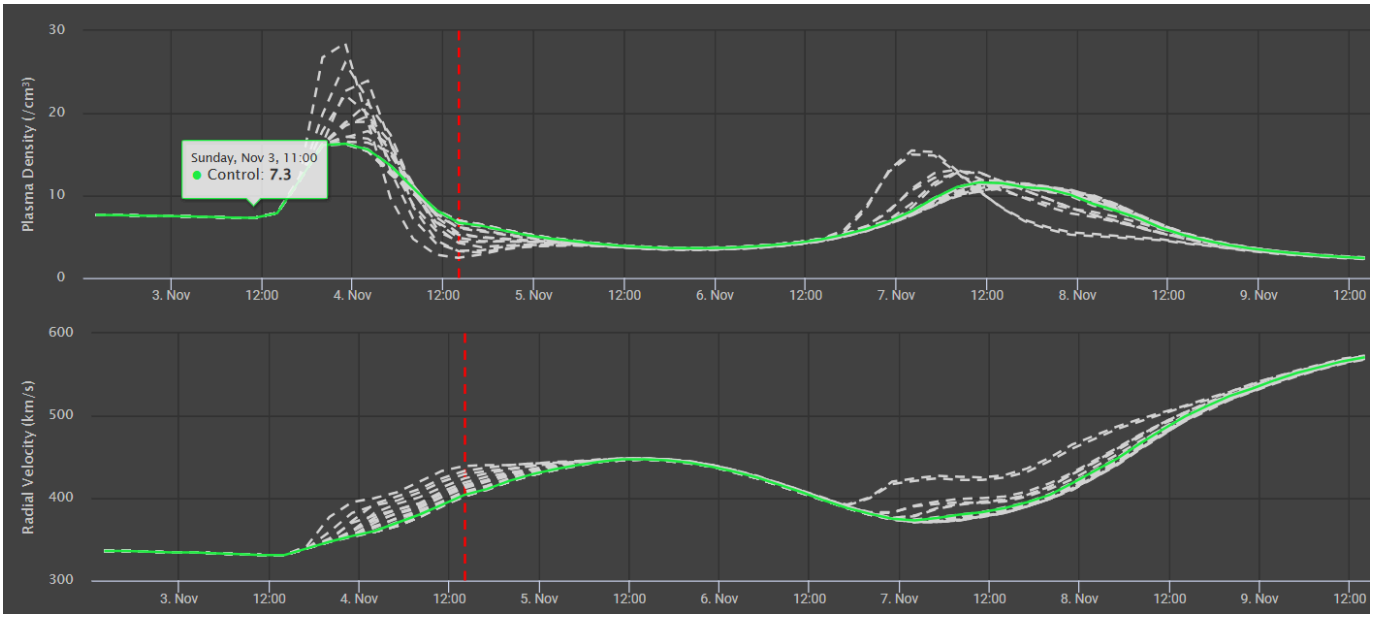
Generally Quiet to Unsettled geomagnetic activity is expected through Days 1 (05 Nov), with a chance of Active and a slight chance of G1/Minor Geomagnetic Storm intervals given the ongoing weak HSS influence. Activity then expected to decline to mainly quiet levels through Day 2 (06 Nov), before perhaps becoming unsettled to active later Day 3 or early Day 4 (07-08 Nov), with a further slight chance of G1/Minor geomagnetic Storm intervals due to further HSS influence.

| Geomagnetic Storm Probability (Exceedance) | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Minor or Moderate** | **G1 to G2** | Yes | 20 | 5 | 20 | 20 |
| **Strong** | **G3** | No | 1 | 1 | 1 | 1 |
| **Severe** | **G4** | No | 1 | 1 | 1 | 1 |
| **Extreme** | **G5** | No | 1 | 1 | 1 | 1 |

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

**Figure 2: MOSWOC Ensemble model showing possible multiple enhancements in coming days due to HSS influences.**






© Crown Copyright 2024. All Rights Reserved.

## Radio Blackouts - X-Ray Flares

There are twelve active sunspot regions visible on the solar disc, including two unnumbered regions. In the southeast, AR3883 has generated multiple M-class solar flares and features three delta spots. The large forward delta spot in this region has now divided into two smaller delta areas, with an additional delta region in its trailing spot. Although the region's magnetic complexity has decreased somewhat in recent hours, its penumbral area has slightly expanded. AR3878 contains a small, weak delta spot in its trailing region, although it continues to decline. AR3881, to the west of centre disc, has lost its small delta spot, with most of its intermediate spots now faded. Spots AR3869-AR3873 continue to approach or rotate around the western limb and as such are difficult to analyse. AR3886 on the eastern limb is gradually coming more into view; it appears to be a sizable region with multiple spots, though it may be split into smaller regions upon further analysis as it rotates further away from the limb. The other spots on the disc are comparatively smaller or less magnetically complex.

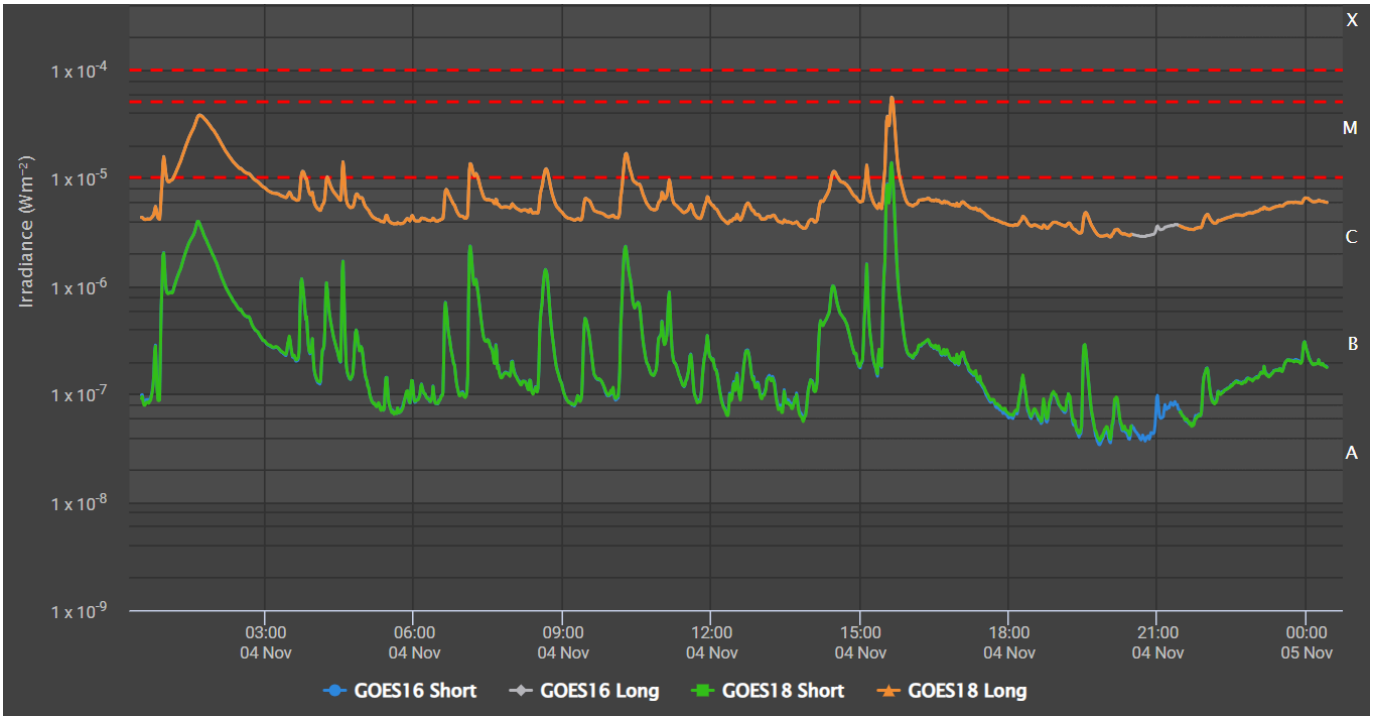
Solar activity was moderate with several M-flares over the past 24hrs, the largest of which was an M5.5 at 04/1538 UTC from AR3883 in the southeast disc. Moderate or High activity is expected to continue, with further M-class flares expected and a slight chance of isolated X-class flares, with AR3883 currently the most likely source for significant flares.

| X-Ray Flares | Level | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability | | | (%) | (%) | (%) | (%) |
| Active | R1-R2 (M Class) | Yes | 80 | 80 | 80 | 80 |
| Very Active | R3-R5 (X Class) | No | 20 | 20 | 20 | 20 |

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

**Figure 3: GOES-16 & -18 X-ray flux for the past 24hrs**






© Crown Copyright 2024. All Rights Reserved.

## Solar Radiation Storms (High Energy Protons)

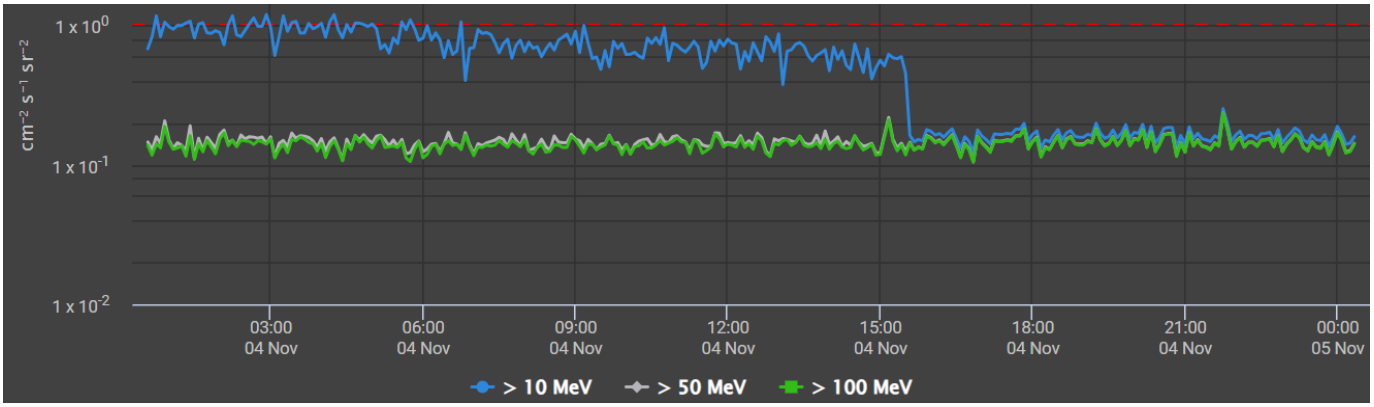
The recently elevated high energy proton flux at GOES-18 has now declined to background levels.

Further enhancements do remain possible however, with the potential for notable flares from a number of the sunspots on the disc. This includes the cluster of regions near or just beyond the western limb, all of which will remain in potentially geo-effective positions for much of the period. The proton risk associated with AR3878 will also only increase into the period as this region transits west, although only limited proton response has been diagnosed from the recent significant flares from this region.

Overall there is a slight chance of further proton enhancement, with a slight declining trend through the period.

| Radiation Storms Probability (Exceedance) | Level ($cm^{-2}sr^{-1}s^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) (%) | Day 2 (00-24 UTC) (%) | Day 3 (00-24 UTC) (%) | Day 4 (00-24 UTC) (%) |
|---|---|---|---|---|---|---|
| **Active** | **≥ S1** | No | 20 | 15 | 10 | 10 |
| **Very Active** | **≥ S3 *** | No | 5 | 5 | 1 | 1 |
| * S3 ≥ 10 MeV ≥ 1000 pfu and/or 50 MeV ≥ 10pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$) | | | | | | |

**Figure 4: GOES-18 Proton flux over the past 24hrs**




Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

## High Energy Electrons (≥ 2MeV)

High energy electron flux (greater than 2MeV) as observed by GOES16 is currently at background and expected to persist mostly at this level, with only brief spells of moderate enhancement expected. A more significant connection to coronal hole fast winds than we are currently seeing could see the electron belts charged up over the next couple of days, with the belts then expanding later in the period, and electron flux levels rising perhaps to more moderate to high levels.

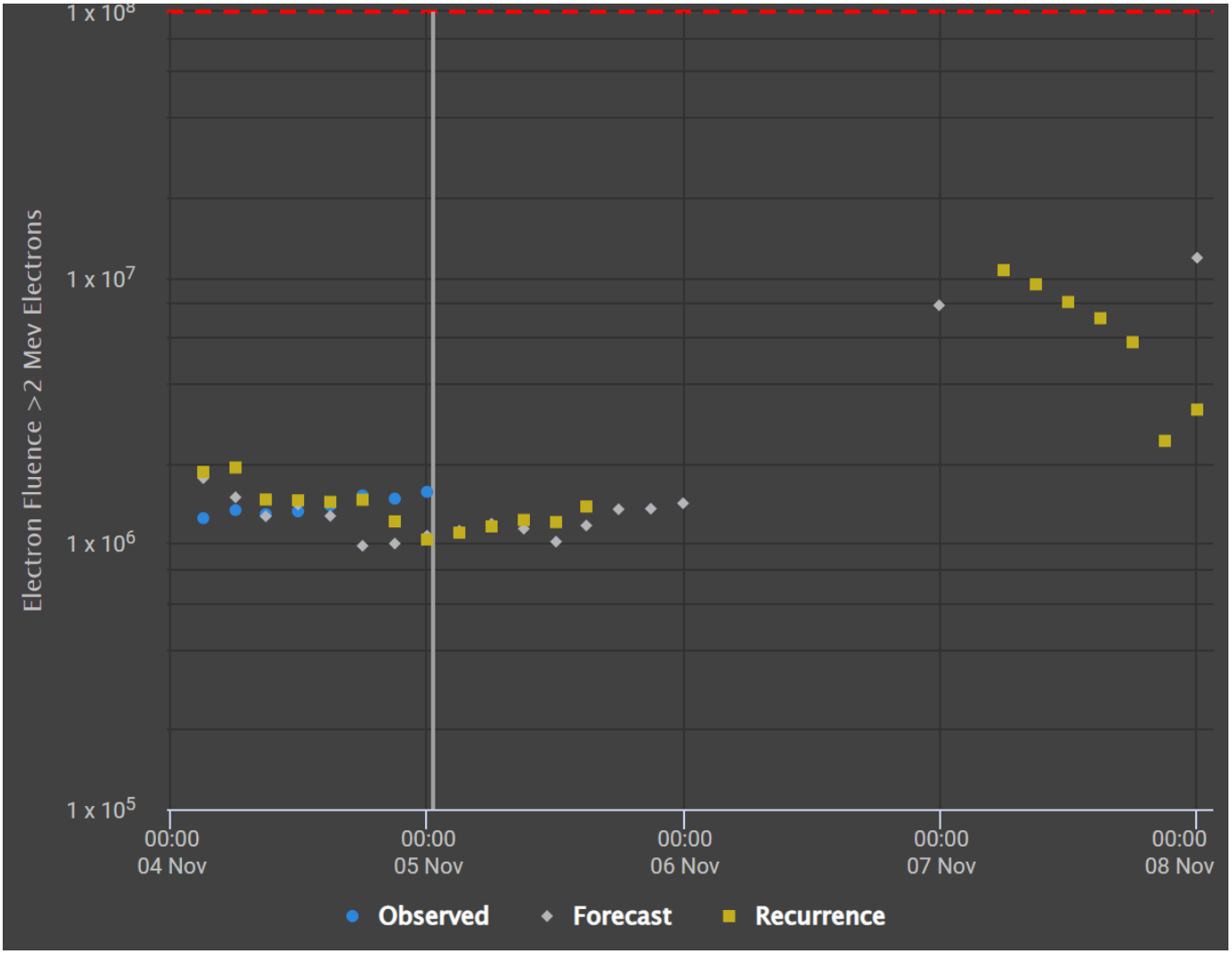
The associated 24-hour fluence is currently expected to remain well below Active throughout the period however, with the MOSWOC REFM forecast though to be providing reasonable guidance.

| GEO Electron Environment | Level ($cm^{-2}sr^{-1}$ $day^{-1}$) | Past 24 Hours (Yes/No) | Day 1 (00-24 UTC) | Day 2 (00-24 UTC) | Day 3 (00-24 UTC) | Day 4 (00-24 UTC) |
|---|---|---|---|---|---|---|
| Probability (Exceedance) | | | (%) | (%) | (%) | (%) |
| Active | ≥ 2 MeV ≥ $1\times10^{8}$ | No | 1 | 1 | 1 | 1 |
| Very Active | ≥ 2 MeV ≥ $1\times10^{9}$ | No | 1 | 1 | 1 | 1 |

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 370 900 0100 Email: enquiries@metoffice.gov.uk

© Crown Copyright 2024. All Rights Reserved.

**Figure 5: MOSWOC REFM model, providing reasonable guidance currently**






© Crown Copyright 2024. All Rights Reserved.